

5 The claimed invention is:

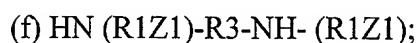
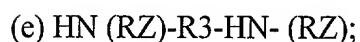
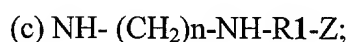
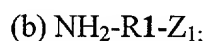
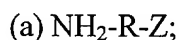
1. A polymeric composition comprising: the linear polymeric reaction product of an amine having two reactive hydrogens selected from the group consisting of; 2-(2-aminoethoxy) ethanol; tris(hydroxymethyl)aminomethane; $\text{CH}_3\text{OCH}_2\text{CH}_2\text{O}[\text{CH}(-\text{CH}_3)\text{CH}_2\text{O}]_n$
10 $\text{CH}_2\text{CH}(-\text{NH}_2)\text{CH}_3$ where n is at least one; $\text{CH}_3\text{-O-(CH}_2\text{CHR-O)}_n\text{-CH}_2\text{CH(-CH}_3\text{)NH}_2$ where n is at least one; $\text{CH}_3\text{O(CH}_2\text{CH}_2\text{O)}_n\text{-(CH}_2\text{CHR-O)}_n\text{-CH}_2\text{-CH(-CH}_3\text{)-NH}_2$, where R is H or CH_3 and n is such that the overall $\text{-CH}_2\text{CH}_2\text{-O-}$ to $\text{-CH}_2\text{-CH(-CH}_3\text{)O-}$ ratio is 70/30; and a glycidyl ether compound selected from the group consisting of diglycidyl ethers of aliphatic diols, triglycidyl ethers of aliphatic triols, and tetraglycidyl ethers of aliphatic polyols, or mixtures thereof.
- 15 2. The polymeric composition of claim 1 further comprising a second amine monomer having two reactive amine hydrogens and a tertiary amine group.
3. The polymeric composition of claim 2 further comprising an amine capping monomer, having one or two amine-hydrogens, reacted with terminal epoxy groups.
4. The polymeric composition of claim 3 wherein the amine capping monomer is selected from the group consisting of diethanolamine, N,N,N'-(trimethyl)-1,3-propanediamine, N-Methyl-D-glucamine and mixtures thereof.
- 20 5. The polymeric composition of claim 1 wherein the diglycidyl ether diol is selected from the group consisting of the diglycidyl ether of neopentyl glycol, diglycidyl ether of 1,4 butanediol, diglycidyl ether of ethylene glycol, diglycidyl ether of polyethylene glycol
25 having a number average molecular weight, M_n , of about 526, and mixtures thereof, and a second amine monomer consisting of (dimethylamino)-propylamine.
6. The polymeric composition of claim 4 further comprising an N-alkylating agent reacted with amine groups.
7. The polymeric composition of claim 6 wherein the N-alkylating agent is an
30 epihalohydrin-containing group.
8. The polymeric composition of claim 7 wherein the halogen is chlorine.

- 5 9. The polymeric composition of claim 6 wherein the N-alkylating agent further comprises a polyoxyalkylene group.
10. The polymeric composition of claim 9 wherein the polyoxyalkylene group is selected from the group consisting of polyethoxy-containing groups, polypropyloxy-containing groups and mixtures thereof.
- 10 11. The polymeric composition of claim 10 wherein the polyoxyalkylene group has a propoxy to ethoxy ratio of from 9 to 1 to about 1 to 9.
12. The polymeric composition of claim 9 wherein the polyoxyalkylene group is methoxy-capped polyethylene oxide.
13. The polymeric composition of claim 6 wherein the N-alkylating agent containing group is an epichlorohydrin capped polyoxyalkylene glycol methyl ether.
14. The polymeric composition of claim 6 further comprising at least one C₁ to C₁₆ alcohol and at least one acid-containing compound.
15. A polymeric composition comprising: the linear polymeric reaction product of a first amine-containing monomer having two reactive amino hydrogens, a second amine-containing monomer having two reactive amino hydrogens and at least one tertiary amine group, and a diglycidyl ether of an aliphatic diol.
16. The polymeric composition according to claim 15 wherein an amine capping monomer having one or two reactive amine-hydrogens is subsequently reacted with terminal epoxy groups on the linear polymeric reaction product.
- 25 17. The polymeric composition according to claim 16 wherein the amine capping monomer is selected from the group consisting of diethanolamine, N, N, N'- (trimethyl)-1,3-propanediamine, N-methyl-D-glucamine and mixtures thereof.
18. The polymeric composition according to claim 17 wherein the amine capping monomer further comprises at least one tertiary amine group.

- 5 19. The polymeric composition according to claim 18 further comprising an N-alkylating agent containing group reacted with amine groups.
20. The polymeric composition according to claim 19 wherein the N-alkylating agent comprises an epihalohydrin-containing group.
- 10 21. The polymeric composition according to claim 20 wherein the halo-group is chlorine or bromine.
22. The polymeric composition according to claim 19 wherein the N-alkylating agent containing group further comprises a polyoxyalkylene group.
23. The polymeric composition according to claim 22 wherein the polyoxyalkylene group is selected from polyethoxy-containing groups, polypropyloxy-containing groups and mixtures thereof.
24. The polymeric composition according to claim 22 wherein the polyoxyalkylene group is methoxy capped polyethylene oxide.
25. The polymeric composition according to claim 19 wherein the N-alkylating agent containing group is an epichlorohydrin capped polyoxyalkylene glycol methyl ether.
- 20 26. The polymeric composition according to claim 19 further comprising at least one C₁ to C₁₆ alcohol and at least one acid-containing compound.
- 25 27. The polymeric composition according to claim 15, wherein the diglycidyl ether of an aliphatic diol is selected from the group consisting of the diglycidyl ether of neopentyl glycol; the diglycidyl ether of butanediol; the diglycidyl ether of ethylene glycol; the diglycidyl ether of polyethylene glycol and mixtures thereof; and the second amine monomer is N, N-dimethylamino propylamine.
- 30 28. A polymeric composition comprising, the polymeric reaction product of an amine having two reactive hydrogens atoms, and an epoxidized olefin having two epoxide groups, and optionally, a second amine monomer having two reactive amino hydrogens and a tertiary amine group.

- 5 29. The polymeric composition according to claim 28, further comprising a subsequently reacted amine capping monomer having one or two reactive amine hydrogens wherein said capping monomer is reacted with epoxy groups.
30. The polymeric composition according to claim 29 wherein the amine capping monomer further comprises at least one tertiary amine group.
- 10 31. The polymeric composition according to claim 30 further comprising a triglycidyl ether of an aliphatic triol.
32. The polymeric composition according to claim 29 further comprising an N-alkylating agent.
- 15 33. The polymeric composition according to claim 32 wherein the N-alkylating agent is an epihalohydrin-containing group compound.
34. The polymeric composition according to claim 33 wherein the halogen is chlorine or bromine.
35. The polymeric composition according to claim 32 wherein the N-alkylating agent further comprises an oxyalkylene group.
- 20 36. The polymeric composition according to claim 35 wherein the oxyalkylene group is a polyoxyalkylene wherein the polyoxyalkylene group is selected from polyethoxy-containing groups, polypropyloxy-containing groups or mixtures thereof.
37. The polymeric composition according to claim 36 wherein the polyoxyalkylene group has a propoxy to ethoxy ratio of from 9 to 1 to about 1 to 9.
- 25 38. The polymeric composition according to claim 32 wherein the N-alkylating agent containing group is an epichlorohydrin capped polyoxyalkylene glycol methyl ether.
39. The polymeric composition according to claim 35 wherein the polyoxyalkylene group is methoxy-capped polyethylene oxide.

40. The polymeric composition according to claim 32 further comprising at least one C₁ to C₁₆ alcohol and at least one acid-containing compound.
41. A polymeric composition comprising the linear polymeric reaction product of at least one first amine-containing group having two reactive hydrogens selected from the group consisting of



where:

R is a C₂-C₁₀ alkyl group- or a hydroxy-substituted C₂-C₁₀ alkyl group;

R1 is (-CH₂-CH₂-O)_n, -(CH₂-CH(-CH₃)-O-)_n, or -(CH₂-CH₂-O)_m-(CH₂CH(-CH₃)-O-)_p- where n, m and p are 1 to 45;

R2 is a C₂-C₁₀ alkyl, or a substituted C₂-C₁₀ alkyl wherein the substituents are selected from the group consisting of alkylamido, hydroxy, alkoxy, halo, cyano, dialkylamine, aryloxy, alkylcarbonyl and arylcarbonyl and mixtures thereof;

5 R3 is a C₂-C₂₀ alkyl or C₂-C₂₀ substituted alkyl wherein the substituent are selected from the group consisting of alkylamido, hydroxy, alkoxy, halo, cyano, aryloxy, alkylcarbonyl, arylcarbonyl, and mixtures thereof;

Z is selected from the group consisting of hydrogen, alkylamido, hydroxy, dialkylamine, alkoxy, halo, aryloxy, cyano, alkylcarbonyl, arylcarbonyl and mixtures thereof;

10 Z1 is selected from the group of hydrogen, an alkyl or acyl group;

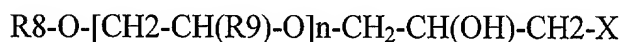
at least one diepoxy-containing compound selected from the group consisting of:

Epoxy-CH₂-O-(R₆-O)_n-CH₂-Epoxy: where R₆ is: a C₂ to C₂₀ alkyl, an alkyl substituted C₂ to C₂₀ alkyl group, an C₂ to C₄₀ alkoxy, C₂ to C₄₀ hydroxy substituted alkoxy where n is 0 to 20;

5 or an alkyl-diepoxy of the formula: Epoxy-CH₂-R₇-CH₂-Epoxy: where

R₇ is a C₂ to C₂₀ alkyl, or a substituted alkyl or alkylene; and

at least one N-alkylating agent selected from the group consisting of epihalohydrin capped polyalkylene glycol methyl ether of the following formula:



20 where

R₈ is selected from the group consisting of, hydrogen, C₁-C₆ alkyl, C₆-C₁₀ aryl, 2-hydroxy-3-chloropropyl, and 2,3-oxopropyl,

R₉ is selected from the group of hydrogen, C₁ to C₆ alkyl where n is from 1 to 120, and

X is a halogen atom.

25 42. A polymeric composition comprising the reaction product of at least one first amine having two reactive hydrogens, selected from the group consisting of methylamine, ethylamine, propylamine, butylamine, sec-butylamine, isobutylamine, 3,3-dimethylbutylamine, hexylamine and benzylamine, 2-amino-1-butanol, 4-amino-1-

5 butanol, 2-amino-2-methyl-1-propanol, 6-amino-1-hexanol, ethanolamine, propanolamine, tris(hydroxymethyl) aminomethane, D-glucamine, 3-amino-1,2-propanediol, 2-amino-2-methyl-1,3-propanediol, 2-amino-2-ethyl-1,3-propanediol, 3-(dimethylamino)propylamine, N,N-dimethylethylenediamine, N,N-diethylethylenediamine, 1-(2-aminoethyl)piperidine, 4-(2-aminoethyl)morpholine, 2-(2-aminoethyl)-1-methylpyrrolidine, 1-(2-aminoethyl)pyrrolidine, and 2-(2-aminoethyl)pyridine, 2-(2-aminoethylamino)ethanol, piperazine, 2-methyl piperazine, 2,6-dimethylpiperazine, 2-(methylamido)piperazine, N,N'-bis(2-hydroxyethyl)ethylenediamine, N,N'-dimethylethylenediamine, N,N-dimethyl-1,4-phenylenediamine and N,N'-dimethyl-1,6-hexanediamine;

15 (b) at least one second amine having two reactive hydrogens and a tertiary amine group selected from the group consisting of 3-(dimethylamino)propylamine, N,N-dimethylethylenediamine, N,N-diethylethylenediamine, 1-(2-aminoethyl)piperidine, 4-(2-aminoethyl)morpholine, 2-(2-aminoethyl)-1-methylpyrrolidine, 1-(2-aminoethyl)pyrrolidine, and 2-(2-aminoethyl)pyridine;

20 (c) at least one diepoxy-containing compound said diepoxy compound selected from the group consisting of: bis(2,3-epoxypropyl)ether, diglycidyl ether of 1,4-butanediol, diglycidyl ether of neopentyl glycol, diglycidyl ether of ethylene glycol, glycerol diglycidyl ether, diglycidyl ether of polyethyleneglycol, diglycidyl ether of polypropylene glycol, the diglycidyl ether from the reaction product of ethylene oxide with propylene oxide, diglycidyl ester of cyclohexane dimethanol and diglycidyl ester of a dimer acid, 1,2,3,4-diepoxybutane; 1,2,7,8-diepoxyoctane, 1,2,9,10-diepoxydecane and 1,2,5,6-diepoxyoctane;

25 (d) at least one amine capping monomer having one or two reactive amine hydrogens, wherein said capping monomer is reacted with terminal epoxy groups, the amine capping monomer being selected from the group consisting of diethanolamine, diisopropanolamine, N-methyl-D-glucamine, N-methylpropylamine, dimethylamine, diethylamine, dipropylamine, diisopropylamine, N,N,N'-trimethyl-1,3-propanediamine,

5 N,N,N' - trimethylethylenediamine, N,N-dimethyl-N-ethylethylenediamine, N,N,N-triethylethylenediamine; and

(e) at least one N-alkylating epichlorohydrin capped polyalkylene glycol methyl ether following formula:

$$R8-O-[CH_2-CH(R9)-O]_n-CH_2-CH(OH)-CH_2-X$$
 where:

10 R8 can be hydrogen, C₁ to C₆ alkyl, C₆-C₁₀ aryl, 2-hydroxy-3-chloropropyl, 2,3-oxopropyl,

R9 can be hydrogen, C₁ to C₆ alkyl,

X is a halogen atom, and n in the range of 1 to 120.

43. The polymeric composition according to claim 42, further comprising the polymeric reaction product of an amine having two reactive hydrogens selected from the group consisting of; 2-(2-aminoethoxy) ethanol; $CH_3OCH_2CH_2O[CH(-CH_3)CH_2O]_nCH_2CH(-NH_2)CH_3$ where n is at least one; $CH_3-O-(CH_2CHR-O)_n-CH_2CH(-CH_3)NH_2$ where n is at least one; $CH_3O(CH_2CH_2O)_n-(CH_2CHR-O)_n-CH_2-CH(-CH_3)-NH_2$, where R is H or CH₃ and n is such that the overall -CH₂CH₂-O- to -CH₂-CH(-CH₃)O- ratio is 70/30; and H₂N-CH₂CH₂OCH₂CH₂-OH, a diepoxy-containing compound, and a triepoxy-containing compound.

44. A polymeric composition comprising

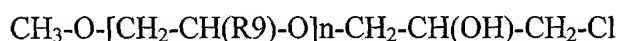
(a) a first amine having two reactive hydrogens is selected from the group consisting of: ethanolamine, propanolamine, and polyoxyalkylamines according to the formula

25 $R4-(CH_2CH(R5)O)_n-CH_2CH(CH_3)NH_2$, where R4 is -OCH₃, R5 is hydrogen or -CH₃, and n is 1 to 45, 2-(2-aminoethylamino)ethanol, piperazine, N,N-bis(2-hydroxyethyl)ethylenediamine, and N,N'-dimethylethylenediamine and mixtures thereof;

5 (b) a diepoxy compound selected from the group consisting of diglycidyl ether of 1,4-butanediol, diglycidyl ether of neopentyl glycol, diglycidyl ether of ethylene glycol, diglycidyl ether of polyethyleneglycols, 1,2,3,4-diepoxybutane, 1,2,7,8-diepoxyoctane and mixtures thereof;

10 (c) an amine capping monomer having one or two reactive amino hydrogen subsequently reacted with terminal epoxy groups, selected from the group consisting of diethanolamine, N-methyl-D-glucamine, N-methylpropylamine, N,N,N-trimethyl-1,3-propanediamine, N,N,N - trimethylethylenediamine, and mixtures thereof, and;

(d) an N-alkylating epichlorohydrin capped polyalkylene glycol methyl ether-containing group having the formula:



where n is 1 to 3 and R9 is selected from the group consisting of hydrogen and a C₁ to C₆ alkyl group.

45. The polymeric composition according to claim 44, further comprising a second amine monomer having two reactive hydrogens and a tertiary amine group selected from the group consisting of 3-(dimethylamino)propylamine, N,N-dimethylethylenediamine, and mixtures thereof.

46. The polymeric composition according to claim 44, further comprising at least one C₁ to C₁₆ alcohol and at least one acid-containing compound.

25 47. The polymeric composition according to claim 46 further comprising an effective amount of a compound selected from the group consisting of alkyleneoxide copolymers, oxyalkylated alcohols, organo-phosphate esters, inorganic phosphate esters, polyglycols, resole resins, novalac resins and mixtures thereof.

48. The polymeric composition according to claim 46 further comprising, an acid selected from the group consisting of arylalkylsulfonic acid; aqueous hydrochloric acid,

- hydrofluoric, sulfamic, acetic acid, formic acid, nitric acid, citric acid, ethylenediaminetetraacetic acid, nitriloacetic acid and mixtures thereof.
49. A method of treating an oil bearing formation comprising the steps of: charging an oil bearing formation with an effective amount of a demulsifier or demulsifier composition according to claim 46 blended per 1000 gallons of an aqueous organic or aqueous inorganic acid solution.
50. The method of treating an oil bearing formation according to claim 49 wherein the effective amount of demulsifier is in the range of 0.01 to about 5 gallons per 1000 gallons of an added aqueous acidic solution.
51. A method of preparing a polymeric demulsifier compound comprising the steps of:
- providing a first amine monomer having two reactive hydrogens
 - reacting the amine monomer with a monomer comprising at least two glycidyl groups or at least two epoxide groups to provide a polymeric reaction product;
 - capping unreacted glycidyl or epoxy groups on the polymeric reaction product with an amine monomer having two reactive amine hydrogens and a tertiary amine group
 - alkylating amine groups on the polymeric reaction product with a N-alkylating agent-containing group to provide a polymeric demulsifier compound.
52. The method of claim 51 further comprising the step of adding a second amine monomer having two reactive hydrogens and a tertiary amine group to the reaction.
53. The method of claim 51 wherein the first amine monomer is elected from the group consisting of 2-(2-aminoethoxy) ethanol; $\text{CH}_3\text{OCH}_2\text{CH}_2\text{O}[\text{CH}(\text{CH}_3)\text{CH}_2\text{O}]_n\text{CH}_2\text{CH}(\text{NH}_2)\text{CH}_3$ where n is at least one; $\text{CH}_3-(\text{CH}_2\text{CHRO})_n-\text{CH}_2\text{CH}(\text{CH}_3)\text{NH}_2$ where n is at least one; $\text{CH}_3\text{O}(\text{CH}_2\text{CH}_2\text{O})_n-(\text{CH}_2\text{CRHO})_n-\text{CH}_2-\text{CH}(\text{CH}_3)-\text{NH}_2$, where **R** is H or CH_3 , and n is such that the ratio of $-\text{CH}_2\text{CH}_2\text{O}$ to $-\text{CH}_2\text{CH}(\text{CH}_3)$ is 70/30.

- 5 54. The method of claim 51 further characterized by reacting 0.5 to 1.4 moles of amines having two reactive hydrogens with 1.0 mole of a diglycidyl ether of a glycol or epoxidized olefin and heating the reactants to between 25 °C to 240 °C for a period of time sufficient for the reaction product to attain a viscosity of at least 80,000 cps.
- 10 55. The method of claim 51, further characterized by reacting 0.7 to 1.2 moles of at least one amine having two active hydrogens, and a second amine monomer having two reactive amine hydrogens and a tertiary amine group with one mole of diglycidyl ether of a glycol or epoxidized olefin between 25 °C to 240 °C for a time period sufficient for the reaction product to reach a viscosity of at least 80,000 cps.
- 15 56. The method of claim 51 further characterized by grafting an N-alkylating agent onto the polymer by reacting the polymer and N-alkylating agent a weight ratio of between 1:1 to 8:1 at a pH between 7.5 and 9.0 at a temperature between 60 °C and 95 °C for a time period sufficient to reach a solution viscosity between 200 and 9000 cps.
- 20 57. The method of claim 51 further characterized by grafting the N-alkylating agent onto the polymer at a weight ratio of between 1:1 to 8:1 of polymer to N-alkylating agent, at a pH between 7.5 and 9.0 and at a temperature between 85 °C and 95 °C for a time sufficient to produce a viscosity between 200 and 5000 cps.
- 25 58. The method of claim 51 wherein the N-alkylating agent is epichlorohydrin capped polyalkylene glycol methyl ether.
59. The method of claim 51 further comprising the step of protonating the polymeric reaction product after steps b and c with an acid.